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Dr. Fuller is an Assistant Professor of Geology, West Virginia University. The diagram which he presents in this article was first used while teaching meteorology at Mt. Union College, Alliance, Ohio. Dr. Fuller is a frequent contributor to scientific magazines in the fields of geology and geography.

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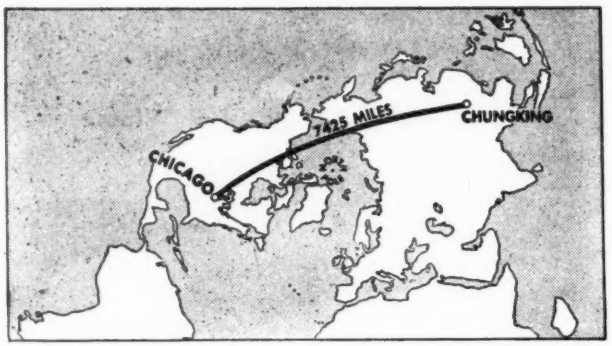

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INTERNATIONAL ASPECTS OF CONSERVATION

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George Peabody College for Teachers

Most of the work in conservation of natural resources has been local, regional, or national in scope. Effective action has not gone, in general, beyond national or empire limits. There are certainly outstanding examples of need for co-operation, however; and there are notable examples, too, of genuine achievements in the field of international conservation, sufficient to justify the hope of more wide-ranging effective action in the near future.

A PROBLEM FOUND EVERYWHERE

Basic to international action is the fact that resource destruction is not limited to a few places but is widely distributed over the entire earth. Indeed, the destruction of natural resources is as old as man and as wide as the inhabited earth. Men cannot live on any part of the earth without tending to damage critical elements in the natural-resource complex. Seeds of destruction are resident in every mode of occupance.

Running thru the conservation literature of the early 1900's is the notion that only the people of the West—folk with the material culture of western Europe—have been guilty of resource destruction. True, they have been exceptionally destructive in a short time, but others have wrought similar damage over a longer period. The hills of interior China have been denuded of forests and soil; the tropical rain forests have been largely cut over. Indeed, the regions of the world may be put in one of two classes, according to whether the destruction has been slow but continuous over a long period of time, or recent and more violent. The hill lands of China and Italy fall in the first class, the grass lands of the Union of South Africa and the United States in the second.

Whether it be the Eskimo with depleted hunting ground, the nomadic Arab searching with his flocks for pasture in areas over-

grazed for ages, or stranded mining communities in the Appalachians; from pole to pole and around the world, men are facing the problems that arise as a consequence of destruction and impairment of the natural-resource base.

With similar problems found in so many places, it would seem that there might well be a sharing of experience, a pooling of the understanding gained from conservational efforts. That such a common body of conservation principles is accumulating is reflected in such publications as *Soil Conservation*. With the discovery in prehistoric times of plant and animal domestication, the soil of the occupied earth came under attack. The plow and other mechanical devices intensified the rate of soil wastage. Recent experiences with the extension of plow culture in tropical Africa verify conclusions regarding the dangers involved; and it is hoped that the lessons learned in regions where the plow has long been in use will find speedy application in these areas of most recent extension of plow culture.

SHARING THE RESOURCES OF A CLOSED SYSTEM

As long as men could meet their needs in their home areas, little thought was given to the fact that all men live within an almost closed system of resources, that of the earth (completely closed off by itself except for the reception of insolation). Now that the sustenance area of commercial peoples is the whole earth and the resources of the earth have undergone noteworthy shrinkage, the fact that world resources are definitely limited becomes of increasing concern.

As mankind approaches the resource limits of the entire world, the experiences of the human race resemble those of islanders who early reached the limits of the resources of their restricted homeland. In some of the South Sea Islands, the bases of life were early subject to severe pressure as populations increased. The limits imposed by the island environments were soon felt—it is no wonder that such practices as infanticide were invoked among primitive peoples to bring the population needs into balance with resources. In a sense, the whole earth is an island, and we have now explored it to its outer limits, and find that its resources, too, are exhaustible. These world limits are particularly impressive for the mineral resources. As recently stated in a report of the National Resources Board, "The whole world is stranded with a limited supply of mineral fuels." Limits on such materials as phosphate

rock may actually prove even more critical in the end.

It is now hard to realize that only 450 years ago a vast, fresh double continent lay open to emigrants from Europe. Today we are entering a new era of land occupation: there are no new, empty, or emptying lands; no lands occupied by weak people and unclaimed or unprotected by great powers. We have reached the end of our wandering by coming back to the starting place. This is the only world we have to inhabit, and we have occupied virtually all of it. We have reached the end of our journey. As a consequence, in the words of Mackinder, "We are now for the first time presented with a closed system. The known does not fade any longer through the half known into the unknown; there is no longer elasticity of political expansion in lands beyond the Pale."

Perhaps no single resource more effectively illustrates the dilemma toward which the world is heading than does the whale. Originally hunted on the Bay of Biscay by Basque fishermen, there is now practically no part of the ocean where whales are safe. Moreover, the resources of the northern hemisphere are largely exhausted, and fishing is concentrated mainly in southern waters. There the whales are exposed to exploitation by all maritime nations, notably Norway and Japan. As a part of an effort to conserve these animals, it has been recommended that there be a global quota of whales; that each capture be reported by radio; and that the season be terminated when the world's quota has been reached. Here we have a worldwide attack on a resource, and the necessity for world co-operation if it is to be conserved. Men have definitely pushed to the limits of our planet so far as this resource is concerned. Petroleum bids fair soon to illustrate this same crowding of the limits of the world's resources; and in time the list of earth's materials for which men ransack the world will be a long one.

Complexities Resulting from Geographic Diversities

Anyone who gives much attention to the international problems of conservation must surely be impressed by the tremendous need for co-operation, and also by the fact that co-operation is made difficult by differences between regions and nations in the kind and magnitude of conservation problems faced.

One of the more fundamental contrasts is between the old, more or less exhausted lands and the new, relatively rich ones. Two French geographers, Brunhes and Vallaux, pointed out many

years ago that destructive occupation marked, in general, the first stage in the settlement of an area. The fur trade of colonial America and the exploitation of soil brought about by tobacco farming in colonial Virginia illustrate this truth. Indeed, it is a safe generalization that prodigal use of natural resources and pioneering life go together. The people of older lands have learned the limits of their resources and are much more willing to apply conservation measures. As a consequence, the older and the younger nations find it difficult to discover a common ground on which to attack their mutual problems. We see the same conflict within a country such as ours, with an older and a younger section. In the West, there is impatience with the desire of the East to withhold the minerals of the public domain from rapid development: the East calls this conservation, the West views it as a needless locking up of resources.

This difference between old and new lands influences the relation of colonial lands and the commercial centers to which they are related. In a colonial area, there is a tendency to exploit the natural resources with little regard for their safeguarding, to trade them for the commodities desired from the mother country. No matter how much England might desire the conservation of the soil resources of the British Empire, it would doubtless meet considerable opposition if it attempted to impose restraints on the dominions or even the colonies.

Too commonly the home country has actually encouraged resource destruction in the colonial area. Men have even boasted that fertility of the fields of the colony was being exported (as grain) to the mother country, there to support livestock, and thru them to maintain the fertility of the fields. As this process goes on, however, there eventually comes a leveling out of resources, and then the true situation is revealed; the welfare of the region or country tends in the end to merge with the welfare of the entire world.

SIGNIFICANCE OF TRADE

The international aspects of conservation are intimately tied up with the movement of goods. The rewards of trade have been a vigorous incentive to resource destruction. Altho we cannot agree with Jacks and Wythe, who blame *foreign* trade exclusively for promoting resource destruction, for this same stimulus operates within the political unit, the fact remains that the destruction

in a colonial area is commonly stimulated by the fact that there is an overseas market where the minerals or wood or ivory can be traded for the commodities provided by the older, more advanced products.

In this day, when the sustenance area of the commercial nation is the entire earth, trade is the means by which the market draws on the distant resource. More and more, attention is being centered on the best and largest mineral resources, the richest soils, the best reserves of wildlife; and the world-wide transportation net which we now have makes it possible for the world demand, as for tin, to center on a relatively few spots. The demand of the entire world is thus brought to an intense focus. It is obvious, moreover, that the area being exploited is not ordinarily under the control of the market; the world has a stake in the conservational production of petroleum in Venezuela, but the immediate political control lies within that country rather than with the buyers.

Here is another way in which trade has worked to the detriment of resource conservation. For the world as a whole, production from managed or conserved resources has had to compete with production from wild resources. The difficulty in making forestry pay is due, in large part, to the fact that timber from managed forests has had to compete with wild timber, which costs nothing or next to nothing to grow. So uninventive and unmanageable have men been that they must needs dissipate the riches of nature before efforts to counteract that depletion become economically feasible.

As trade has been the principal relation involved in the impact of one nation on another's resources, so interferences with trade have marked and will mark efforts to counteract resource shrinkage. As critical materials become scarcer, nations will be tempted to limit exports. Peru has already done this for guano. Canada forbids the export of unmanufactured pulpwood taken from crown lands. We have talked about applying a similar export tariff to phosphorous rock; indeed, we have even given serious attention to regulations which would aim to prevent all export of this critical raw material.

It is easy for men to fall into two directly opposing camps on the issue of control or restriction of the export of materials deemed critically important to national well-being. On the one hand, it may be argued that these materials should be kept at home because they are badly needed. On the other hand, it may be urged with

equal fervor that no nation has a right to keep exclusively to itself the natural resources with which it is endowed. From a very practical point of view, it would appear to be of doubtful wisdom to refuse to share with other nations, for no single nation on earth is in a position to live entirely without the aid of raw materials and goods from others. Mutual aid rather than selfish attention to one's own needs alone would seem to be the proper course to pursue.

A special aspect of the relation of international trade to resource destruction is that presented by the growth of cities. There is much justification for the view held by the Russian geographer, Woeikof, that the destructive tendencies of the Nineteenth Century were largely traceable to the rise of cities. He held that the city dweller is so far removed from nature that he is unmindful of the damage he is doing. As I see it, the detrimental effect of cities on resources rests not on the blindness induced in urban dwellers but on the fact that they provide such a splendid market for the raw materials of rural areas. While it is true that the city dweller is commonly quite unconscious of the waste that is going on in the areas on which he draws, nevertheless it is the reward of trade that prompts that exploitation. The great cities of the world have grown up pretty largely since the 1870's and 1880's. Together with the development of rapid cheap transportation, they have contributed their share toward aggravating the international problem.

The Impact of Nationalism

The world-wide depletion of natural resources which has accompanied the growth of world commerce has been unquestionably in part a result of that growth. Whether the trend toward nationalism, which in some ways runs counter to international trade, will result in a corresponding improvement in the general situation remains to be seen.

Economic nationalism has certainly done at least this, it has directed attention to the natural resources of the nations, their character and extent. It has stimulated the taking of inventories, one of the necessary steps in all wise conservational activity. In some countries, particularly this one, governmental action has gone so far as to encourage the spending of human resources to conserve the natural—such as the employment of CCC workers in forest conservation during the depression years.

An essential part of the requirements of economic nationalism

is national planning. If planning is carried far enough, it can but give direct attention to the problem of resource depletion. Here is another way in which nationalism promises much in terms of resource conservation.

Underlying the whole relation between nationalism and conservation is the fundamental fact that the state is assumed to have immortal life. To exist an indefinitely long time, it must have a material basis. Accordingly, the safeguarding of the natural-resource base becomes one of the principal obligations of the state.

This urge toward national self-sufficiency may have the effect of promoting conservation at home but of intensifying the destructive impact of that nation on foreign areas. The Japanese have been remarkably successful in safeguarding their soil, forests, and water power, but to date they have flatly refused to co-operate in whale conservation. They have also destroyed the wildlife resources of certain islands which they did not intend permanently to occupy, while at the same time they have safeguarded these same resources on their own home areas.

The close tie-up between economic nationalism and conservation has convinced some students of the problem that conservation is limited solely to national self-interest and that it cannot escape these limiting bonds. It is easily possible, of course, to look at the whole matter in that way. On the other hand, it is just as logical to note that the nation is the largest practical unit for achieving or negotiating a world-wide conservational program. In this regard as in others, it appears that the highest interest of the individual nation will be served by providing arrangements for international solutions to problems that go beyond the range of the home country. Indeed, there are some grounds for thinking that we could scarcely move on to an international plane without first passing thru the nationalistic stage.

RESOURCE GROUPS OF PARTICULAR SIGNIFICANCE IN INTERNATIONAL CONSERVATION

Sharply Localized Fund Resources. Reference was made previously to the fact that the people of the earth are "stranded" with a limited amount of mineral resources. The development of technology has made each major country dependent upon the mineral resources of other lands, and the rise of world commerce has enabled that world-wide demand to focus on relatively small areas. It thus becomes of major importance that these limited resources

be used wisely in the interest of the people of the entire world. There is, therefore, need for international co-operation toward that end. This seems a very large order and an ideal that may possibly be quite a long way off. On the other hand, the depletion of certain resources, such as petroleum and tin, is going forward at such a rapid rate that some kind of co-operation is most assuredly needed.

At a time when the world is at war, it may seem to be rather absurd to suggest that world-wide co-operation in mineral conservation is a possibility. This doubt merely points to the fundamental truth that underwrites all conservation theories—the one way in which the nations of the world can co-operate most effectively to safeguard natural, as well as human, resources is to settle their quarrels in some other way than thru the instrument of war. War has been and continues to be the most destructive process known to man. The elimination of war would dwarf all other achievements in international conservation.

Sharply Localized Renewable Resources. Like mineral resources, there are certain renewable resources which are subject to world-wide demand but are found in only a few places on the earth. Perhaps there is no better example than the sandalwood of the Hawaiian Islands. Exploitation of sandalwood was slow to start but grew rapidly after 1810, when native chiefs began to grasp its economic significance. So rapid was the destruction of the sandalwood of the Islands that by 1825 the supply was practically exhausted. Certainly it is to the interest of the world as a whole that these sharply localized resources be not completely destroyed, altho the actual application of conservation principles must of necessity be carried out by the nation holding the resource. Quite different are the resources which are shared or held in common.

Shared Resources. There is no field in which international co-operation is more needed and can be more effective than in the safeguarding of the shared resources, those resources which belong in part to one nation, in part to another. It appears that these resources are primarily, if not exclusively, of the circulatory kind. Resources which move from one country to another consist mainly of waters and wildlife.

It is a commonplace in water conservation that, if a stream is to be used most effectively, the entire drainage basin must be taken as a unit. A river basin is a natural, a hydrographic, unit, and to the extent to which it is used it must be regarded as a human-use

unit too. Any change, for example, that is made in the quality and quantity of the water in any part of the system is passed downstream and affects people at a lower level. Accordingly, wherever a drainage basin is shared by two or more nations, an international problem of considerable importance results. Here is one of the more promising places for international action toward resource conservation. The United States has several international problems of this sort. The Colorado River and the Rio Grande present problems of co-operation with Mexico in connection with the development of irrigation, and the utilization of the water power of the lower St. Lawrence requires co-operation between the United States and Canada. Europe has a great many such opportunities for international action, notably in connection with the wise use of the Rhine and the Danube.

Migratory wildlife constitutes another shared resource, one that can scarcely be safeguarded without full co-operation of all the countries concerned. Fortunately we have a fairly satisfactory arrangement between the United States and Canada in the protection of migratory birds. One cannot say so much for our relations to our neighbors to the south. Of these southern countries, at least six have no protective laws at all. Only Argentina, Brazil, and Uruguay have local laws approaching adequacy; and there is evidence that much of the national domain in each of these countries is covered only casually and that enforcement is rare. The West Indies are also a source of strain on the supply of birds that migrate between the United States and the mainland of South America. One of the worst offenders is the densely peopled Barbados, where snipe, for example, are slaughtered, with full support of the law, not only on the island's natural swamps but on some twenty-odd specially constructed ones. We are reminded in this connection of the point made by Raymond Cushman Murphy that conservation must be continental in scope in order to be most effective. The co-operation of two or more countries in safeguarding the water resources of a drainage basin is pretty largely dependent upon official action; international co-operation in the conservation of wildlife depends not only on official action but also on the wholehearted co-operation of the individual citizens of the various countries. To put an end to the slaughter of song birds in southern Europe, as well as northern, or in North America, as well as South America (at both ends of the range of migration), would appear to be an extremely difficult problem but not an insurmountable one.

Resources Held in Common. Ranking with shared resources as a promising place at which to enlarge international conservation within the near future are the resources held in common. These resources consist primarily of the wildlife of internationally owned or controlled waters, mainly the great ocean areas, but also including such international waters as the Great Lakes.

Time after time, the Great Lakes states have endeavored to regulate fishing in such a way as to maintain the supply undiminished. The history of each attempt has been the same. There has been no great difficulty in getting representatives from the various states and Canadian provinces to agree on minimum essentials. The real difficulties lay in getting the various state legislatures to enact these regulations into law and in securing enforcement of them once they were enacted. To date it has not been possible for all of the states and provinces to secure anything like a common front in attacking the depletion of fish in the Great Lakes area.

Another problem which urgently calls for international co-operation is the depletion of the haddock on George's Bank, east of the coast of Massachusetts. It is definitely demonstrated that haddock that are too small are being caught and sold. The recommended regulations are relatively simple. They include a minimum mesh size for use in the trawls and a minimum market size for the fish that can be landed. These regulations would, of course, have to apply to all of the vessels visiting this area if they were to be most effective. Most closely involved in this problem are the United States and Canada.

One might cite numerous illustrations of the need for co-operative action and of failure to achieve it. On the other hand, there are notable examples of high accomplishment. We have commonly pointed to the treaty arrangements between the United States and Canada in conserving the halibut of the Pacific coast and to the arrangements between the United States, Japan, Canada, and Russia for the conservation of the seals of the Pribilof Islands. Even here, however, there is real reason for concern. The agreement to conserve the halibut fisheries is between the United States and Canada; a ship outfitted in Great Britain to visit these waters was finally stalled off by joint action of these two countries. There is no guarantee, however, that some other nation may not break into the area, violating the treaty regulations. Moreover, in 1941, Japan abrogated the Fur-Seal Convention which had regulated the taking of seals in the Pribilof area since 1911. Discussions be-

tween the United States and Japan were under way when the Pearl Harbor incident occurred.

Utilizing the "pastures of the sea" is one of the principal ways in which men can supplement the food derived from the land. In terms of direct use the ocean has little other value except for transportation. It is, indeed, a sad comment on man's ability to cooperate to solve obvious problems of major international import, when he fails to meet the problems which our ocean fisheries present.

War Versus Mutual Aid

All suggestions for international efforts toward resource conservation fade into comparative insignificance beside the one calling for the elimination of war as a means of settling disputes. The Second World War sped up the rate of depletion of mineral resources to a point that is almost inconceivable; it has brought about the destruction of soil and forest resources in each of the major countries involved; in bringing non-agricultural land into crop use, it has laid the foundation for a more serious soil erosion problem in the post war years; it has cancelled out practically every cooperative agreement between the various nations now ranged on opposite sides. As a cause of destruction of natural resources, Twentieth Century war stands unrivaled; no conservation measure could possibly outrank the displacement of war by peaceful means of settling international disputes.

CLOUDS

J. OSBORN FULLER
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Everyone has watched with interest the changing array of clouds. Few, however, know the appropriate names for the different forms of these fleecy masses, altho remembering their names is the first step toward understanding them. Man balks at learning isolated terms. Even students in meteorology have difficulty in learning various cloud types if they are just listed and described. Cloud observations become enjoyable if the relationship between

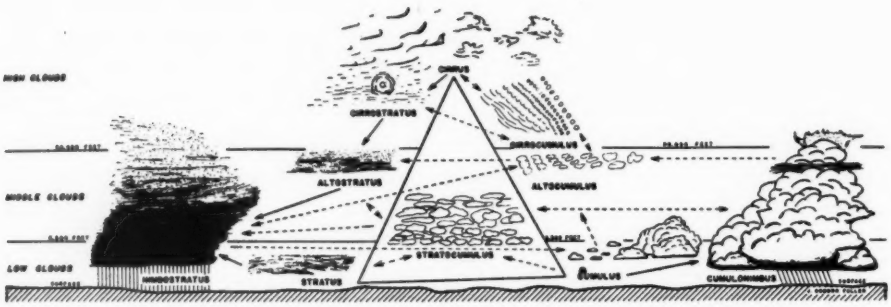

FIG. 1. Cloud diagram. A graphic method of showing nomenclature, form, and inter-relationship of the principal cloud types.

the cloud types is appreciated and the transition from one type to the next is understood.

It is discouraging to the beginner to discover that it is often impossible to classify the clouds from a single observation. However, realization that the unknown clouds are a transition from known to other known types will heighten the interest of the observer, rather than dishearten him.

Clouds develop from the moisture in the air. All air contains invisible vapor which is the gaseous state of water. Chilling of the air causes the water vapor to condense and become visible as clouds. If this change takes place above 32° F. (approximate) tiny droplets of water form; if below 32° F. (approximate) ice crystals form. Warming of the air tends to dissipate the droplets of water or ice crystals, but frequently the clouds pass thru a series of changes before dissolution. The possible changes are indicated on the cloud diagram by arrows (Fig. 1).

This simple triangular diagram is designed to facilitate learning the various cloud types. It does not represent a possible arrangement of clouds in the sky but merely shows the relative positions of all of the cloud types above the surface of the earth. The clouds in their actual position are spread over a much wider horizontal distance than is shown on the diagram. The three main types, *stratus, cirrus,* and *cumulus,* are located at the apices of the triangle; between the apices are gradational but distinct types. The two special rain forms, cumulonimbus and nimbostratus, are outside of the main triangle in their relative positions above the earth's surface.

FIG. 2. Cirrus. Fleecy masses scattered over sky without pattern. (All photographs, except Fig. 5, courtesy of U. S. Department of Agriculture, Weather Bureau.)

Clouds are classified according to height in three main groups; namely, low, middle, and upper clouds. In making cloud observations, the first step is to determine the group in which the cloud

FIGS. 3 and 4. Cirrus. Approaching storm winds cause cirrus to stretch out and assume definite pattern. Fig. 4 shows cirrus fusing to form cirrostratus near the base.

Cloud	Abbr.	Symbol	Elev. Above Ground	Color	Form	Composition	Precipitation	Location	Miscellaneous
Cirrus	Ci		High clouds Mean lower level 20,000 feet	White.	Delicate, fibrous, without shading.	Ice crystals.	None.	Borders of distant disturbance or above other clouds. Often not visible.	Silky, most varied shapes of all cloud types. Haloes rare.
Cirrocumulus	Cc			White.	Small, globular masses or flakes in lines or ripples.	Ice crystals.	None.	Front or lateral edges of a weakening disturbance.	Rare. Should show connection with cirrus or cirrostratus. Called mackeral sky. Individual elements smaller than 3 fingers width with arm extended.
Cirrostratus	Cs			White.	Thin veil.	Ice crystals.	None.	Fringes front of center of disturbance and N. lateral edge.	Not so frequent or conspicuous as cirrus. Haloes.
Altocumulus	Ac		Middle clouds 6,500 to 20,000 feet	White to gray.	Layer or patches of globular masses.	Ice crystals and water droplets.	None but often virga.*	Extreme lateral edge of disturbance, or front of weak disturbance, or thunderstorm, or rear after showers.	Small globular patches may look like Cc but if associated with Ac also are called Ac. No connection with cirrus or cirrostratus.
Altostratus	As			Gray or bluish.	Striated or fibrous veil.	Ice crystals and water droplets.	Virga, rain, or snow but no heavy rain.	Central part of typical disturbance.	No halo. No shadows visible. Nimbostratus darker. In front of sun sky like frosted glass.
Stratocumulus	Sc		Low clouds Surface to 6,500 feet	Gray with darker parts.	Layer or patches of fairly large globular masses.	Ice crystals and water droplets.	Virga, rain, or snow but no heavy rain.	Common winter clouds outside or on extreme edges of disturbance.	Individual elements, larger than 3 fingers width with arm extended.
Stratus.	St			White to gray.	Uniform layer resembling fog but not on ground.	Water droplets.	Virga, or may fine drizzle or snow.	Common winter clouds outside or on extreme edges of disturbance.	Some contrasts in light and dark therefore different from Ns.
Nimbostratus	Ns			Dark gray to black.	Low, amorphous, nearly uniform.	Water droplets and, at high levels, ice crystals.	Virga or continuous rain or snow.	Just before central part of typical disturbance.	Darker than As, soft undersurface, completely hides sun and moon.
Cumulus	Cu		Low clouds with great vertical development 1,600 to 20,000+ feet	White to gray, gray base.	Thick with vertical development. Domed top, flat base.	Water droplets and, at high levels, ice crystals.	Slight.	Fine weather, hot humid days or in strong wind at rear of disturbance.	Typically appears about 10 A.M., grows and dissolves toward evening.
Cumulonimbus	Cb			Dark gray to black.	Heavy masses with great vertical development.	Water droplets and, at high levels, ice crystals.	Virga, thunderstorms, showers of rain, snow, hail.	Hot humid days or in strong wind at rear of disturbance.	Must show transition at top into false cirrus otherwise still cumulus.

* Note: Virga—Thin trailing precipitation from the cloud which does not reach the ground.

belongs. The diagram shows all of the principal cloud types in their respective groups. Thus, from these diagrammatic sketches, the *probable* cloud type can be determined. An accurate identification can be made by referring to the photographs and to the chart, which gives other characteristics of the cloud types.

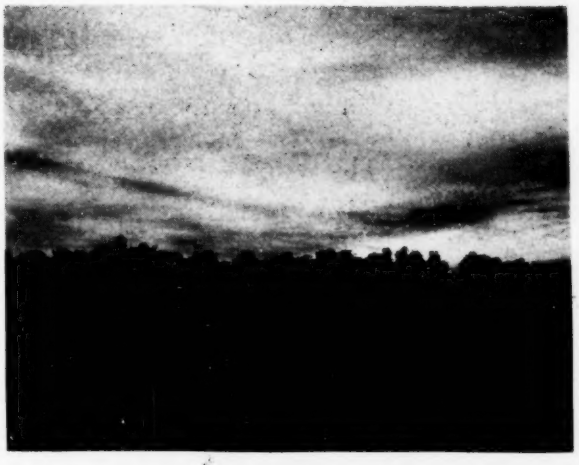

FIG. 5. Cirrocumulus. These puff balls grade into cirrus in upper right hand corner. The picture suggests a heavier cloud cover than was present. (Courtesy of Dr. W. Storrs Cole.)

The solid arrows on the diagram indicate the common changes from cloud type to cloud type. The dashed arrows show the less frequent but possible variations. One of the most frequent changes occurs when a storm approaches and passes. This cloud sequence indicating the approach of a storm is shown on the left side of the diagram. The first sign of an advancing disturbance is the appearance of cirrus clouds (Fig. 2). These fleecy, thin, brilliant, fibrous masses, made up of ice crystals, are scattered over the sky. As the storm approaches, the cirrus masses stretch out into more fibrous bands (Figs. 3 and 4). This cirrus type fairly flies before the storm. Sometimes this sky is accompanied by cirrocumulus clouds (Fig. 5) in which case the small puff balls usually are arranged in lines. Low fair weather cumulus

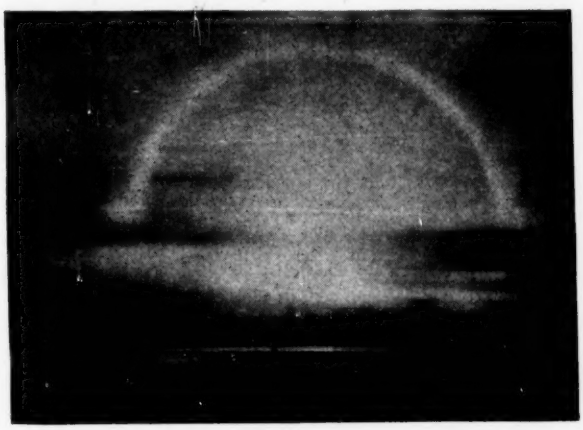

FIG. 6. Cirrostratus. Picture suggests much thicker cover than is actually present. Halo definitely proves that it is cirrostratus.

FIG. 7. Altostratus. The thickness of this altostratus layer varies. The sun is masked but its position can be determined.

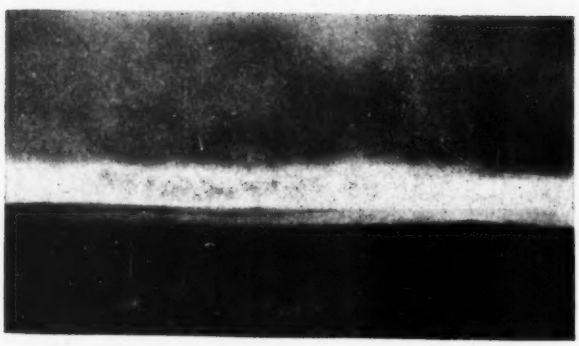

FIG. 8. Nimbostratus. The upper cloud layer is the dark layer of nimbostratus. This thins and lightens in the distance to become altocumulus.

FIG. 9. Cumulus. Note darkened and flattened bases. These are fair weather cumulus clouds.

clouds also may be present. As the storm gradually approaches the cirrus clouds thicken to form a thin white veil of cirrostratus clouds (Fig. 6). It is with these clouds that a halo or "ring around the moon or sun" is observed. With the further advance of the storm

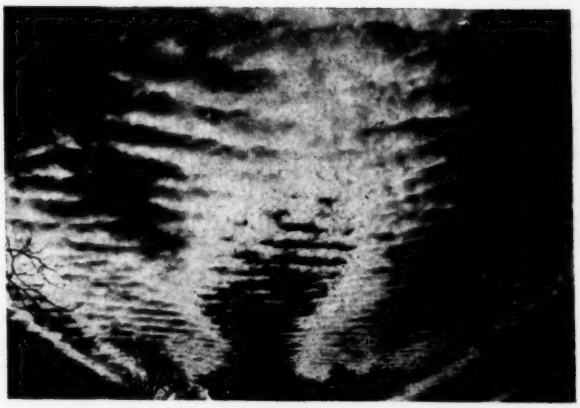

FIG. 10. Altocumulus. Fairly thick cloud cover with linear arrangement of the cloud masses.

FIG. 11. Cumulonimbus. The mass of cloud has built up to tremendous height and now is starting to feather out on the edges. This is the beginning of the formation of an anvil top. A shower is visible below the central mass of the cloud.

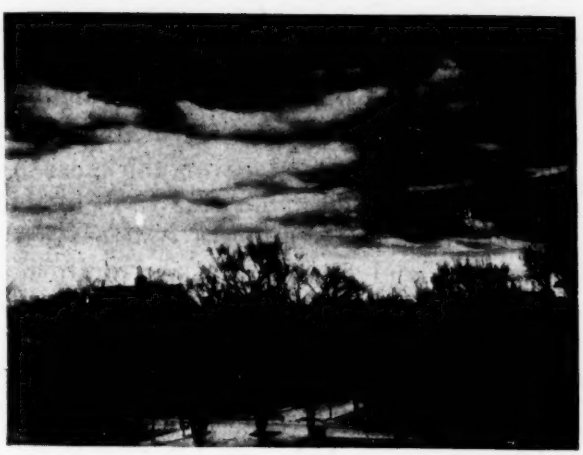

FIG. 12. Stratocumulus. Irregular rolls of varying light and shade. These clouds did not form from cumulus. If they had formed from cumulus clouds the cover would be thinner and the rolls even less regular.

the cirrostratus veil thickens and lowers to form the typical altostratus (Fig. 7). The sky is darkened. The sun is masked by the cloud, but its position still can be determined. Globular patches of altocumulus clouds sometimes stand dark and warning against the background of grey altostratus. The atmosphere suddenly seems to clear beneath this murky vault. Distant objects stand out sharply in the limpid air. Rapidly the eerie light darkens and the sun disappears as the altostratus veil lowers. The thickening altostratus soon passes into nimbostratus (Fig. 8) and rain falls. Precipitation usually lasts for several hours, but it may last a whole day. The rain is continuous, the atmosphere is humid, visibility is bad, and the day is generally depressing. After the rain stops the sky clears and the sheet of nimbostratus and altostratus passes by with a fairly sharp rear edge.

FIG. 13. Stratus. Uniform fog-like layer with little contrast of light and dark.

With the passing of the storm a variety of cloud types may appear in the sky. If the observer is south of the center of the disturbance there is a period of relatively clear skies before the cold front sweeps down to cause showers along the squall line. The clouds of this period are usually scattered cumulus (Fig. 9) and altocumulus (Fig. 10), the latter becoming more abundant as the cold front approaches. The inrushing cold air forces the warm air upward and the cloud cover thickens. Altocumulus passes into cumulonimbus; and under this vault of the patchy masses, the air again seems transparent. In contrast with the pre-rain vault of even cover and later depressing uniformity, this cloud cover is exciting. There is a diversity of color, shade, and shape not seen in the former case. At first, dark grey to black rolling masses of cumulonimbus (Fig. 11) dominate the sky. Often these bring rain in sudden downpour. Occasionally there is lightning and a few peals of thunder. After the shower the cumulonimbus masses part,

revealing patches of deep blue sky dappled with brightly lighted cumulus clouds. These stormy weather cumulus clouds are distinguished from the fair weather cumulus by more ragged bases and more bulging tops. Sometimes the cumulus clouds are flattened to produce a layer of stratocumulus (similar to Fig. 12), stratus (Fig. 13), or altocumulus. This type of sky may persist for several days after the passing of the storm. The number of cumulonimbus clouds decreases and the cumulus clouds become more abundant. The tops of the cumulonimbus spread out in anvils forming dense false cirrus clouds. Finally the last cloud floats by and the sky is clear. The approach and passing of a typical storm, as described above, must be modified if the disturbances follow each other closely, or if the observer is north of the storm center. In these cases there is little clear sky. The cloud sequence is different if the observer is on the lateral edge of a disturbance, if the disturbance is weak, or if the conditions promote thunderstorms. Some of the other possible evolutions are indicated by arrows on the diagram. In using the diagram it should be noted that the left side is composed of types that form almost complete sky cover, while the right side is composed of the isolated patchy cloud types. Broadly speaking, the left side represents a cold front series and the right side a warm front series.

This cloud diagram has been used in teaching for several years. It is presented to a larger audience in the hope that it will stimulate cloud observation. The author is indebted to Dr. W. Storrs Cole of the Ohio State University and George W. Minling, Senior Meteorologist of the Columbus office of the Weather Bureau, for criticism of the manuscript.

MAP READING

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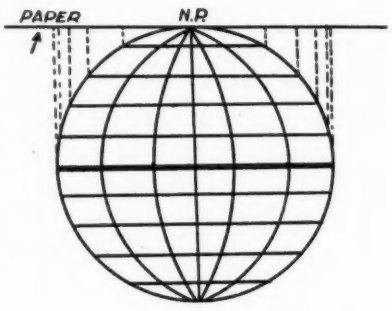
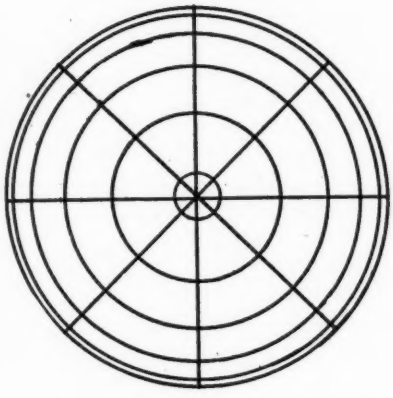
LESSON VIII. THE NORTH POLAR MAP



Today we are going to talk about a kind of map which is becoming more and more important. Geographers use all the methods we have mentioned in making it. We'll call it the North Polar Map. All we need to know about how it's made is that usually the mapmaker places a flat piece of paper so it touches at the North Pole. He then copies off the lines of latitude and longitude as they would look if they were reflected thru a lighted globe. The network looks like this ⟶ something like a wheel with spokes. If you locate the North Pole on your desk map you'll find that it is in the center—the hub of the wheel. Now find the equator. It is a circle, is it not? The 30th parallel north is a circle. Find the 60th parallel south. Each parallel then is a circle—or a rim running around the center hub. On your map the parallels are at equal distances from each other. Perhaps you could check this by putting one leg of a compass on the North Pole and the other on a parallel. Trace the course, and then move the leg to another parallel. All these parallel circles have the same center. What does this mean as to distance from the center of the map? Simply this. Every point on a parallel is the same distance from the center of the map as every other point on that parallel. Parallels are small circles on the globe, of course, but many of our maps do not show this. This map makes it very clear.



Parallels of latitude show east and west direction. Yet here they are circles. Do you remember that west is clockwise and east is counter-clockwise? Put your pencil on the equator somewhere in

Africa. Move it *clockwise* until you come to the next continent—South America. Check with the globe. South America is *west* of Africa. Start with South America and move counter-clockwise. Where do you come out? Africa, we hope. Africa is *east* of South America. You should practice following a parallel east or west, saying the directions to yourself and then checking with the globe. Try saying these directions:

Africa to and from Australia
South America to and from Australia
Canada to and from Russia

The meridians on the North Polar map are straight lines going thru the pole. Find the prime meridian or Greenwich meridian and the 180th meridian opposite it. Follow the 90th meridian west over the pole to the 90th meridian east.

These meridians show us true north and south. Following any meridian toward the North Pole, you are going north. Following any meridian away from the pole you are going south. Practice on these places.

Greenland to and from South America. Say to yourself, "From Greenland to South America—away from the center of the map—south."

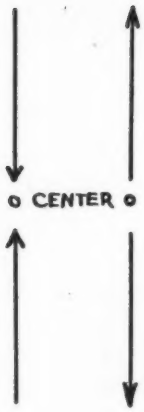
India to and from northern Russia
England to and from Africa
Japan to and from Australia

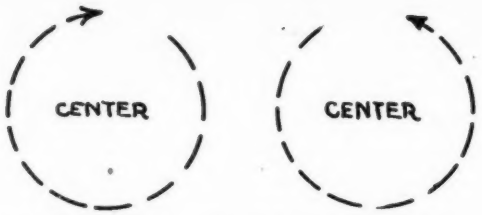
The combined directions like north-east, south-west are a little harder to figure out just at first. Probably the people who have trouble with north, south, east and west had better not go on with this step. Some of you may want to work on this. We know that from New York to Alaska is north-west—we don't even need a globe for that. Locate the two places on this map. Move your pencil from New York in the direction of Alaska. Say —"toward the center of the map—north. Clockwise—west, northwest." If that seems easy try these:

India to China; China to India
Panama to London; London to Panama
Alaska to Panama; Panama to Alaska
Japan to Alaska; Alaska to Japan

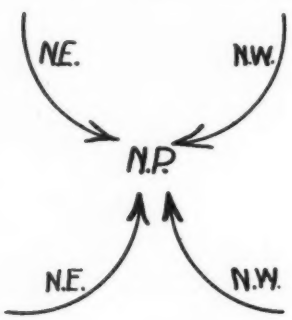
Can you do it?

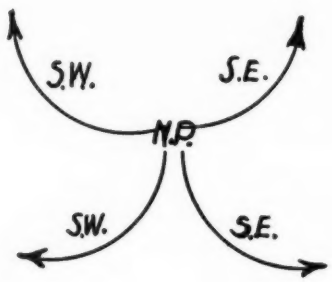
At the top of the next page is a little picture summary of directions on this map.

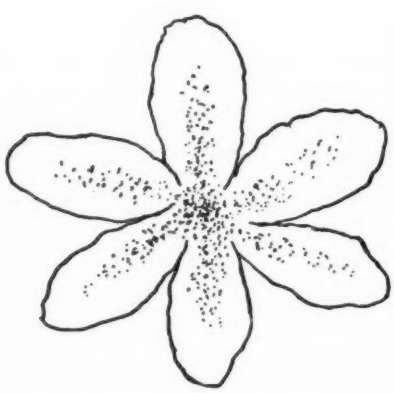




You have probably noticed by now that some of the continents look rather strange on this map. What is the reason? This map tries to flatten out the earth just like all maps. It is fairly easy to flatten out the northern half of the earth. If you have experimented with oranges in other lessons you remember that half of an orange flattens out without too much tearing. But the other half is another story. The sketch will give you an idea of how much the southern hemisphere has to be stretched or torn in order to be put on a flat map. The copy of the North Polar Map you have *stretches*





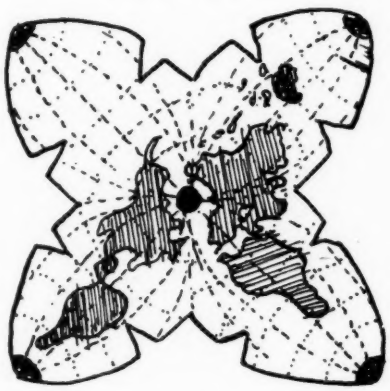


the southern hemisphere. This pulls some countries out of shape. Those *farthest* from the North Pole are most out of shape. South America is the worst. Why? Then come New Zealand, Australia and Africa.

The countries which are best shown are those closest to the North Pole. Greenland is practically perfect. Norway and Sweden and Northern Russia are fine. So are North America and Europe. This is important because these countries are among the largest, richest, and most populous in the world. This map shows the relationships among them.

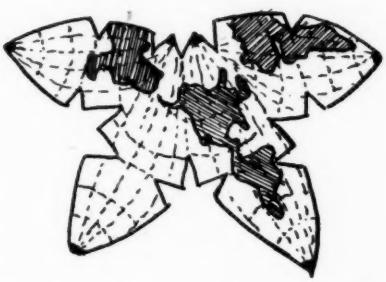
Some map makers have chosen to tear the southern hemisphere rather than stretch it. You will see many North Polar maps which look like these.

Pole Star Map



Five Star Map

Butterfly World Map



They are all the same sort of map. The pole, parallels and meridians are the same. The interruptions will not confuse you if you realize that the map maker was tearing the southern hemisphere instead of stretching it.

There is no scale on your map. You can find approximate distances by using degrees of latitude, the way you learned before.

Great Circles are easy to see on the North Polar map. If the line connecting any two places runs thru the North Pole it *is* the great circle route. Other great circles are almost straight lines. Plot the great circles you know. Tokyo to San Francisco and New York to London, and others.

There are many reasons you should become familiar with this map:

1. It shows the relationships of the northern hemisphere very clearly.

2. It is a good map for showing air routes—which usually follow great circle paths.

3. It is valuable in following the war news. You can see the route of convoys from Newfoundland to Murmansk better on this map than on any other.

You will remember:

1. Parallels are shown as circles with the North Pole in the center. Parallels show us east and west directions.

2. Meridians are shown as straight lines thru the pole. They run north and south.

3. Distortion increases on this map with distance from the pole.

4. No one scale can be used on this map.

NEW CALEDONIA

ELIZABETH STADTLANDER
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Appearance

New Caledonia is the second largest island of the Pacific. It is a big cigar-shaped island 248 miles long with an average width of 31 miles and a surface area of 8,548 square miles.

Structurally it is closely associated with New Guinea. A ridge sank beneath the ocean and coral reefs formed from one to ten miles offshore. These reefs are separated from the island by a pale green-blue lagoon. The western and eastern sides are fronted by an almost continuous reef. The western reef stretches for 400 miles and ranks second to the Great Barrier Reef of Australia. Gaps in the reefs occur mostly opposite the mouths of the numerous, short, swift streams.

New Caledonia consists of two parallel ranges nearly 6,000 feet in altitude that run the length of the island. From this backbone of mountains, spurs run down almost to the water's edge. These form many penned-in valleys with fertile floors. Also forming valleys are the short rivers which have gouged channels on their way to the sea. However, the main direction of the mountain ranges is the same as that of the prevailing South East Trade winds. Therefore, only the northern and southern ends of the island are well-watered; while many parts of the interior are desert-like in aridity.

Generally speaking there are three levels to the surface of New Caledonia. From the coastal lowlands, the climb is to a hilly plateau. Here are wide stretches of open country overgrown with bush or coarse grass and dotted with gray-green niaouli trees. This is mainly grazing land—unbroken miles of it—with only now and then a frame house standing beside a fenced-in garden. Where a river winds thru, there are scattered ferns, an occasional coffee plantation, and more rarely a cluster of houses or a village.

Above the plateau are the slopes of the cloud-ringed central chain. These are black with forests of precious hardwoods . . . ebony, sandalwood, rosewood, ironwood, and kauri. These forests are little exploited because of the cost of getting the lumber to the coast. To many, the tall, incredibly thin "column pines" topping the bare headlands here and there look like a cluster of masts.

THE CLIMATE

New Caledonia is said to be the least tropical of the tropical islands. From May to December the climate is cool and generally dry, and it is far less humid than might be expected due to the arrangement of the mountains. The average temperature for December to March—the hot season—is 72°; for June to October—the cool season—the average is 65°. Extremes of temperature range from 50° to 98°. Therefore, frost is unknown.

The rainfall varies considerably during the year. For example, at Noumea on the west side of the island, the average rainfall is 40 inches with 70% or 28 inches falling during the hot months. The eastern side of the island is the windward area and thus receives the most precipitation.

THE VEGETATION

Due to the mountainous character of the island and the climatic conditions, the vegetation varies greatly. On the mountainous areas grow only hardy native plants—mostly scrubby shrubs. In fact, more than one-half of the surface is too rugged for cultivation.

However, the valleys are very fertile. In some of these sections, plants such as grasses, lantana, guava, acacias, aloes, and wild lemons have been introduced. Under the favorable conditions of fertility and sufficient rainfall of the northern and southern ends, the areas have been overrun. Miners and explorers wear heavy denims and boots as protection against lantana growth. Tree ferns up to 60 feet as well as dense forest flourish in the valleys. Coconut palms line the beaches on both coasts and on the low west shore mangrove swamps are prolific. In the more fertile valleys of the island coffee, coconuts, manioc, corn, cotton, tobacco, pineapples, and bananas are produced. In spite of the arability of the valleys the lack of a suitable labor supply has left the greater part of the island undeveloped.

THE PEOPLE

The people of New Caledonia are known as Kanakas. They are a blend of two racial stocks—Polynesians and Melanesians. They are black-skinned, heavy featured, frizzy-haired individuals with short, stocky bodies. They are stubborn by nature, but intrepid fighters. Before the arrival of the white man, the Kanakas were divided into small, jealously isolated, mutually hostile tribal groups, as a result of topography.

This isolationism is reflected in the language. There are traces

of twenty distinct languages found in the natives' speech. Today these are blended into a "lingua franca" which is basically a degenerate French.

These Kanakas practice a primitive polytheism. They believe in a kind of shadowy double for each person, called a "ko." "Ko" remains in residence during the waking hours, but goes out on its own affairs, frequently getting into mischief, during sleep. It is strictly tabu to waken a sleeping man lest his "ko" fail to get back on time from its wanderings.

The native races, or Kanakas, however, decreased in number due to warfare among the tribes, which incidentally has practically stopped, and due to white man's diseases. Measles have killed 40,000 natives in a single year. Influenza wholly depeopled some of the smaller islands. Tuberculosis contracted from one individual can kill off an entire village in six months.

The present white New Caledonians are hardy, independent people. The pioneer spirit within them is strong. Their "unruly independence" is attributed to Anglo-Saxon influence brought about by New Caledonia's proximity to Australia.

More numerous today than the remaining blacks are the Japanese and Malayans introduced by the French for laborers. The native had his own method of working. He would work in the cool of the morning or evening, or he would work when he felt inclined. This type of laborer was just as unsatisfactory to the plantation owners as was convict labor. Convict laborers were expensive because they had to be paid and fed (the white man needs more food than the native). They, too, worked only halfheartedly. Therefore, the importation of the Japanese and Malayans was a solution.

Today the Japanese on New Caledonia are the fishermen, the market gardeners, and the opium dealers. More have entered during recent years under false pretenses. An example is the boatload of Japanese "troca fishers" who came to grief in a cyclone and proved to be a crew of Japanese naval officers.

New Caledonia, nevertheless, has a higher percentage of Europeans than any other French colony. In 1926 the population was 51,876 including 2,310 convicts. In 1931 the number of inhabitants had increased to 57,165.

MINERAL WEALTH

New Caledonia is extremely rich in minerals. Found within the rock strata of the island are nickel, gold, copper, silver, lead, 20,000 tons of iron ore, cobalt, magnesite, zinc, antimony, manganese,

and mercury. There is a difference of opinions as to the coal deposits. Some authorities list coal among the minerals, while others say that it is shipped in from Australia.

The early attempts to develop the deposits of minerals failed because of a lack of good labor supply. Plenty of the natives were comfortable land owners and could not be induced to work so strenuously in the mines.

However, the island was attractive to foreign investors. Indentured laborers with three to five year contracts were imported. From Netherlands Indies came the Javanese and from French Indo-China came the Tonkinese.

Nickel is by far the most valuable mineral. The Caledon-Nickel Company controls the richest mines. Up to 1935 only "pigs" of nickel were shipped out. In recent years Japan and Germany showed a marked interest in the metal production. The Nippon-Soda and Krupp companies developed a process for the profitable extraction of nickel from low-grade ore. By 1938 annual shipments of 33,000 metric tons were being sent to Germany and Japan.

During this time a new mining company of all Japanese capital quietly bought up several mines of poor quality ore. The Japanese financiers appointed French directors for the company to conform to local laws. They installed costly machinery for operations. Then they endeavored to obtain the right to import Japanese labor. But the New Caledonians had become uneasy about the Japanese situation. Nevertheless, some Japanese migrated to New Caledonia as miners and traders.

These nickel mines are located in the mountains at altitudes varying from 800 to 2,000 feet. The Japanese iron ore developments are at the southern end of the island.

OTHER HUMAN ACTIVITIES

Stock ranks second to minerals in importance in New Caledonia. Much of the stock roams thru unfenced grasslands, mountains, and forested areas. Once or twice a year wild cattle are rounded up by a special corralling method known as "travail au calicot." The stockmen from the various stations form a corral of 36″ cotton cloth in the shape of a "V," which is about one-half mile long. As the horsemen beat the bush, the wild cattle are driven toward the wide end of the "V" into the corral.

These wild cattle are then mixed with the tame ones. After having no food or water for four or five days, they are sufficiently sub-

dued to follow the tame cattle to the fattening pastures in the valleys along the coast. Four or five months later they are taken on hoof to Noumea or the meat-canning factory at Ouaco.

A common pest, because of its destruction to the pastures, is the wild deer. But the hunting of the wild deer is comparatively easy and profitable. Natives track them down. With the help of dogs, which drive the deer into water holes or into the sea, hunters frequently bag five or six deer a day. Australia is a ready market for deer hides. Up to 60,000 are shipped to Sydney or Brisbane yearly.

Like stock-raising and deer-hunting, fishing is an economic necessity. Fish are plentiful. They vary in form from the tiny sardine to the kingfish which may average over 50 pounds. Every variety and color of fish may be found on the coral reefs.

Several methods of fishing are employed. One, which carries a severe penalty, is, the unsportsmanlike but productive, dynamiting of fish. As much as 200 pounds of fish may be gained by throwing a single cartridge into the lagoon.

Compared with our use of lobster pots, the New Caledonians have a queer method of capturing lobsters. The lobsters are found on the coral reefs at the southern end of the island. Attaching a dead squid to the end of the pole, the fishermen move the pole in front of the underground grottoes of the reef. This terrifies the lobster into immobility. A diver, with goggles to shield his eyes and gloves to prevent hand injury, captures the lobsters. These sea animals look like the Florida spiny variety and have an excellent flavor.

The Government

New Caledonia was discovered in 1774 by Captain Cook, but the coast was not thoroly explored until 1792-1793 when Bruni d'Entrecasteaux and Huon de Kermadec stopped while in search of the lost La Perouse. From then until about 1850 New Caledonia was an island refuge for seamen, a hideout for runaway convicts from New South Wales, and a haven for fortune hunters. Neither the British nor the French took steps to establish sovereignty because of the fierce warlike habits of the Melanesians. In 1853 the French government stepped in after the crew of a French survey ship was killed and eaten on the island.

In 1864 the French set up a penal colony which was used until quite recently. Many of the New Caledonians are descendants of released convicts who won their freedom for good behavior and preferred to settle in the charming climate rather than to return to

France. Therefore, today New Caledonia is as French as any land could be outside of France.

Since 1878 and 1881 when it was necessary for the French to put down native uprisings, the French have held the people in strict subjection. A time-honored French policy of colonial subordination placed the effective power in the hands of metropolitan officials and frequently failed to take into account the needs of the colony. Thus the free development of New Caledonia has been somewhat hindered. The appointment of French authorities to New Caledonia has been generally reserved for beginners in the diplomatic service.

Many a French gendarme has been sent out as Head Commissioner. Only one ever really succeeded in getting the Kanakas to work for themselves. He suggested that if they wanted to keep the land they must plant it. If they would plant coffee, he guaranteed them a market. On that basis the Kanakas planted hundreds of acres of coffee.

The island is divided into three domains—state lands, penal lands, and native reserves.

With the administration at Noumea the French govern the New Caledonian dependencies of Isle of Pines, Wallis Archipelago, Loyalty Islands, Futuna, Alofi, and Huon.

At present the Free French have control of the island. They have clamped down on all Japanese interests. The colony is strongly pro-ally, and is used as a supply base, as well as an operational and hospital base for the United Nations.

TOWNS

Around the island are a number of small ports and open roadsteads, at which chrome, nickel, and iron ore are loaded and shipped. Also there are several big undeveloped bays with fine natural harbors like the one at Prony.

Hienghene is one of the most beautiful spots on the island. The bay is surrounded by high cliffs, grottoes, and limestone rocks. Emerging from the sea are two pinnacled giants known as the "Tours de Notre Dame." The blue of the sea, the red of the plateaus, and the gray-green of the niaouli trees form the background of Hienghene.

On the southern side near Noumea is the bathing resort of Anse Vata. During the warmer months the white people congregate under the palm trees; but at sunset the land breeze brings swarms of non-malaria bearing mosquitoes. The bathers then return to town

and the little bathing village is deserted.

The largest city of the island is Noumea, a town of about 10,000 population. Noumea is the chief port of the island and is located where it is well protected from storms. The harbor is vast, deep, landlocked by its protecting reefs, and surrounded by brown hills. In front of Noumea is the bare low island of Nou with the town and airport of Nouvelle occupying the site of the former bagne or penal settlement.

From the air Noumea gives the impression of a town of red roofs, water, and gardens. From the sea Noumea looks like a huddle of iron roofs against a burnt peeled hill and smoking stacks of the Caledon-Nickel Company.

Within the city is a large central square planted with a tree peculiar to New Caledonia. It has broad spreading flat tops. In summer (November) the branches blossom into a solid mass of red flowers with no leaves at all, similar to the magnolia tree. From the hills behind the city, the square then looks like a huge red tent top.

The narrow streets of the city are crowded with people of all shades and colors. Native men in loin cloths clamor to carry baggage. Native women appear in simple, stiff-looking, print dresses, while the white women might easily have stepped from the latest Parisian style book.

Since Noumea is a regular stop in the route of the Pan-American Clipper between the United States and New Zealand, the Grand Hotel du Pacifique is the center of social activity for white visitors.

There are many sources of entertainment in Noumea. Several horse racing courses entice horses and jockeys to make a four day trip by steamer from Sydney for the racing season.

At 8 o'clock each night a cannon is fired. After that only white men are allowed on the streets unless a special permit is obtained. The natives are granted permits to attend the movies.

There are three movies in Noumea. Formerly New Caledonia was the graveyard for French films. With French captions and American activity portrayed, what ideas do the Kanakas receive from the films?

But the movies serve more as a social gathering or a night club. Altho all cafes and bars close at 10:00 P.M., the movies operate from 9:00 to 1:00 A.M. with two intermissions of one-half hour each. All the patrons adjourn to the courtyards adjoining the theaters for dancing, smoking, and drinking.

Noumea is a busy town. It is the chief port with 60% of the trade going to Brisbane or Sydney. It has the wireless station for the island and serves as the railroad terminal for the railway from Bourail, the capital.

At the Noumea docks you would find minerals, meats, and coffee being exchanged for copra, native coffee, cotton, tobacco, minerals, maize, and bananas. Hides would be destined for Australia, trochus shells for France, beche-de-mer (trepany for soup) for China, Sandalwood with its sweet aroma for the Oriental ports, nickel for Germany and Japan, and so forth.

Strategic Position

From the appearance of the island and of Noumea, a visitor would expect to find easy means of travel and well developed systems of communication. However, the island lacks roads. Before 1929 there were barely 100 miles of roadway. Now there are three roads suitable for auto and truck travel across the island and a fairly well gravelled road from Noumea to the northern section, a full day's drive.

Regardless of roads, towns, or natives, the mineral wealth and the strategic position have made New Caledonia a pre-destined victim for agression. Altho New Caledonia is 14,000 miles or two months by ship from France, it is an important link in a chain of air communications between America and Australia. It flanks the life-line over which men and equipment have been pouring. The first Pan American flight from San Francisco to New Zealand in Sept., 1940 took four days.

Up to the present time New Caledonia has remained the chief French possession in the Pacific.

RUBBER FROM HAITI—A BATTLE AGAINST TIME

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The Battle of Rubber in the Western Hemisphere is an uphill fight against imposing obstacles. In the production of natural rubber, it is a battle to move men and supplies into trackless jungles to tap wild trees. It is a battle to lay the foundations for a long-range plantation industry. Above all, for immediate war needs, it is a battle against time—a race to produce sufficient natural rubber to meet war requirements while our major former rubber supply sources in the Far East are closed.

Yet nature cannot be hurried by the urgencies of wartime. It takes on the average seven to eight years to get rubber production from the Hevea tree, the most prolific producer among hundreds of latex-yielding plants. At the fall of Singapore in January, 1942, the huge rubber plantation industries of Malaya and the Netherlands Indies represented many years of development work and large expenditures of capital. Hundreds of thousands of workers were engaged in tapping, handling and distributing rubber from the plantations of the Far East. These plantations and distributing organizations could not be duplicated quickly elsewhere.

Fortunately, at the fall of Singapore, the United States had a substantial stockpile of natural rubber to help bridge the gap until synthetic factories and the inter-American natural rubber program could produce in a measure sufficient to offset the supply losses in the Far East. The inter-American program of cooperation in development of the natural rubber industry in the tropical Americas was beginning to make more rapid progress when the supply crisis arose after Pearl Harbor. In Haiti, the Societe Haitiane-Americaine de Development Agricole (Haitian-American Agricultural Development Corporation), better known as SHADA from the initials of its French name, had begun work on the establishment of a rubber plantation industry, based mainly on the Hevea tree. SHADA is a Haitian organization, supported by credits from the Export-Import Bank of Washington and technical aid from the United States. Haiti, with climate and soil favorable for tropical agriculture, with a large reservoir of manpower in proportion to its territorial size, was judged well suited for a rubber industry. SHADA was a going concern ready to take a large hand in the

rubber program when the loss of the Far Eastern supply sources made it imperative to use every possible means to increase rubber production in the Western Hemisphere—and to increase it quickly regardless of cost.

So SHADA, at the outset in its career, assumed a front line position in the Western Hemisphere's Battle for Rubber. And SHADA undertook to grow rubber fast. SHADA's vehicle for the race with time is cryptostegia, a quick-growing vine, which produces a high grade of natural rubber, comparing favorably in quality with latex obtained from the Hevea tree.

In October, 1942, SHADA contracted with United States procurement agencies for the planting of up to 100,000 acres of cryptostegia to help meet emergency needs for natural rubber. Now, after a year, the cryptostegia project is beginning to produce rubber. Production starts with a trickle, but we expect it to increase to about 3,000 long tons in 1944, and 10,000 to 12,000 tons in 1945. The project in Haiti, so far as we know, is the first large-scale effort to produce rubber from the cryptostegia vine. Aside from the immediate need for natural rubber, it should make a useful demonstration of the productive possibilities of cryptostegia in comparison with production from Hevea and Castillon trees and from newly-built synthetic rubber factories.

More than 30,000 acres already have been planted to cryptostegia in Haiti. By the end of 1943, we expect to have between 60,000 and 85,000 acres cleared and planted and to bring 10,000 acres into production by the start of 1944. Before the end of 1944, the entire planted area should be in production, for cryptostegia's main advantage in the battle for rubber is quick production. The Cryptostegia vine can be tapped within a year after planting. And since time is the big element in the wartime Battle of Rubber, cryptostegia was chosen as one of the best bets in the race to increase natural rubber production in the Americas as quickly as possible. SHADA has about 65,000 Haitians working on the cryptostegia project. After planting, these workers continue as tappers when the vines come into production.

When SHADA undertook the cryptostegia program, 1,000 acres of wild plants in Haiti were available as a source of propagating material. We knew it was possible to tap the vine and that it would yield rubber of high quality. But field procedures we had to learn and devise as the project evolved. We also had to devise a method

of tapping the vines. These problems, we believe, have been solved satisfactorily in view of the limited time available for research and experiment. We figure now that SHADA can produce rubber from cryptostegia at an over-all cost of about 60 cents per pound, and we hope to learn more and more to improve further both producing and tapping methods.

First note the characteristics of cryptostegia. The plant is a native of Madagascar. It is a strong and beautiful vine, with much the same habits as a climbing rose. The cryptostegia plant, however, has no thorns. It is covered with glossy green leaves and a profusion of lavender fragrant flowers, shaped something like small Easter lilies. The plant long has been cultivated thruout the warm parts of the world as an ornamental vine. Its ability to produce high quality rubber has been recognized for at least fifty years but SHADA's project in Haiti is the first attempt to use it on a commercial scale. The life of the cryptostegia plant is indefinite, with an expectancy of at least 25 years on plantations. The tapping is not injurious to the plant. On the contrary, SHADA's plants seem to gain under the tapping operation, to produce more rubber and to become larger during the first year or so.

Actual field development in the cryptostegia program in Haiti started January 1, 1943. The first two or three months were spent chiefly in organization and obtaining land. Initial field plantings were made in February, when 2,000 acres of seed were planted. During the final months of 1942, SHADA had planted about 100 acres of nurseries and 60 acres for experimental purposes.

In May, 1943, approximately 20,000 acres of seed had been planted. By then it was apparent that direct field seeding was not sufficiently successful or cheap to be considered the best method. Instead the planting of nursery-grown stumps of small plants proved cheaper and more satisfactory. So SHADA stopped direct field seeding for large-scale nursery development. From mid-May to mid-August, more than 1,800 acres in irrigated nurseries were planted, yielding in excess of 500,000,000 sturdy young plants. These stumps are planted at the rate of between 400 and 500 acres a day, involving the setting out daily of from 2,800,000 to 4,500,000 plants.

At the start, each of the young plants was placed in a carefully dug hole and the soil was replaced by hand. This was slow and laborious. It cost about $10 an acre to plant 10,000 plants by this

method. The cost of the operation, however, was reduced by use of a steel dibble. With the dibble, SHADA's planting crews now set out 7,000 plants at an average cost of about $3 an acre.

The second great problem was how to gather the rubber—whether it was best to obtain it as latex or as coagulated pieces of rubber. In the early stage of the cryptostegia project, much skepticism existed as to whether it was practicable to collect latex from billions of plant stems without incurring exorbitant tapping costs. SHADA's work on this problem started with the understanding that the stems would have to be grouped into bunches. Then SHADA's technicians set about finding the best way of obtaining latex from the bunched stems. A simple machine was developed which now enables the Haitian worker to tap on the average from one and a half to two acres a day. This is another factor in keeping down production costs.

The tapping is done this way: the tappable whips, or long climbing branches, are gathered into bunches of from eight to twenty each. The bunches are tied about four feet above the ground and then tied again toward the end of the stems. The bunches remain tied until tapping cuts back past the tie. The worker places the bunched stems in a clamp at the top of the tapping stick, and, using a sharp knife, cuts the stem about one inch above the ends. The cut ends are saved for each end has a small plug of rubber, similar in shape to the rubber at the end of a pencil.

After the stems are cut, the latex drips for about three minutes thru a small funnel in the tapping stick into a container. A tapper handles about ten tapping sticks and taps from 800 to 1,600 bunches daily. Each plant is tapped every alternate day thruout the year, save for periods of extreme drought. SHADA tappers are producing approximately 300 pounds an acre a year from young plants. This compares with production of about 300 to 400 pounds from Hevea seedlings under average circumstances, and about 500 pounds an acre annually from Hevea after six to ten years of growth.

When the containers on the tapping stick are nearly full, the tapper transfers the latex into a milk pail and carries it to the farm factory. There the latex is put in large tanks, then drawn off into small coagulating tanks, where it is mixed with approximately six times its volume with clear water. The latex immediately coagulates. The soft coagulum is pressed into sheets, rolled and then put thru a marking roller which gives the sheets a waffle-like appearance. The

sheets are soaked in water to remove impurities, dried and smoked over fire for about seven days. Tests of the smoked sheets show SHADA's rubber to be equal to the best Hevea for all practical purposes.

Cryptostegia latex, like the latex of other rubber-producing plants, contains only a relatively small amount of rubber in comparison with moisture and other non-rubber substances. The water coagulation method washes away the non-rubber material. SHADA's research has revealed some fifteen or twenty other methods of coagulating cryptostegia latex. None has been found to be as satisfactory as the water coagulating method. Recently SHADA discovered how to condense and to preserve the latex indefinitely in a liquid form, also how to coagulate the condensed latex and make it at will into good rubber. Cryptostegia latex is acid in its reaction. So cryptostegia latex may prove useful for processes not available to Hevea latex, which is basic in its reaction.

These improvements in cryptostegia operations illustrate the possibilities for reducing costs thru practical experience. How much can be done toward the goal of lower production costs remains to be seen. One important point about cryptostegia must be considered in gauging its long-run chances of staying in the production battle. The cryptostegia plant is comparatively free of disease. No serious pathological diseases have been found for cryptostegia.

Moreover, cryptostegia is about in the same development position as Hevea was in 1900. Then cultivated Hevea plants mostly were seedlings. No high-producing Hevea varieties had been developed thru research and experiment. In Haiti, SHADA is carrying on, simultaneously with planting operations, extensive research with the object of producing better-yielding strains. Already SHADA's research efforts have uncovered plants which are three times as productive as the average. More than 100 individuals have been found which produce at least three times the average. Unfortunately, this tendency toward high production is not always carried thru to the grafted progeny of the high-yielding plant. So far as we know, SHADA's research is the most concentrated effort yet made to improve cryptostegia's productive capacity.

As we learn more about cryptostegia, and improve the efficiency of field operations, the long-term production prospects naturally become brighter. One advantage of cryptostegia is the short development period. This means invested capital is tied up only a year or so before production starts, in contrast with seven to eight years of

Hevea rubber. Still, unless cheaper tapping methods and higher producing strains can be developed, cryptostegia undoubtedly will have difficulty competing with Hevea on a straight price basis in the event of a return to former competitive conditions in the world rubber markets. There is, in addition, the new competitive factor of synthetic rubber. Yet, all things considered, cryptostegia rubber may become commercially valuable. It has qualities which may prove useful for special purposes and thus command a premium in the rubber markets.

Meanwhile, the SHADA project is the first large-scale test of the commercial possibilities of cryptostegia. Aside from its immediate purpose of adding quickly to the Western Hemisphere's sources of natural rubber, Haiti's role as a rubber-growing laboratory is not restricted to cryptostegia. The development of a long-range plantation program based on the Hevea tree proceeds along with the cryptostegia operation. Substantial acreage is being planted to Hevea seedlings, to provide stock for rubber plantations which should come into production over the next decade. This carries out plans conceived before Pearl Harbor, in recognition of Haiti's favorable conditions for tropical agriculture, and need of additional cash crops which find a vast and ready market in the nearby United States.

Both rubber and sisal—Haiti's major contributions to the United Nations in way of strategic materials—hold prospects of increasing the income of the Haitian people. Agriculture is the primary occupation of Haiti's 3,000,000 population, living within an area of only 10,700 square miles. The Haitian rural dweller lives largely by subsistence farming. He could advantageously use sources of cash income, such as tapping a stand of rubber trees, while retaining his self-sufficient status as a food producer. Neither cryptostegia nor Hevea rubber planting will crowd Haitians off the land. All the operations of SHADA—large as they are—occupy less than two per cent of the total area of Haiti. Most of the land brought under cultivation by SHADA formerly was in a wild or semi-wild state. Less than one-half of one per cent of Haitian land has been taken out of its usual usage by SHADA.

EDITORIAL NOTES AND NEWS

It is reported that the first successful planting of Philippine abaca in the Western Hemisphere took place in 1925. In that year 1350 plants from the Philippines, after being cared for on a 43-day sea voyage to Panama, were set out in a plant quarantine station on a nearby island. Tho many of the plants failed to grow, the progeny of those that survived became the foundation for future plantings in Panama, Guatemala, Costa Rica, and Honduras. The hard fiber from these plants is arriving in the United States in increasing quantities to help offset the loss of imports of Manila hemp from the Philippines. Further large-scale planting is being developed, along with machines to process the fibers. Indications point to a supply in 1945 of about 15 to 20 per cent of our former imports. Samples of fibers tested at the National Bureau of Standards at Washington compare favorably with imported yields. The abaca plant resembles the banana plant, its close relative. The overlapping leaf stems when mature form a plant 6 to 12 feet high. The fiber which is obtained from the outer part of each leaf stem ranges in length from four to six feet.

Waters pouring down from a large snow field on lofty Mt. Ixtaccihuatl are to be utilized for hydroelectric power and irrigation in central Mexico. Chief function in the past of this famed extinct volcano has been to serve as a mecca for tourists.

Both Peru and Brazil have launched Victory Garden programs for the increase of foodstuffs.

The following news item has been supplied by Dr. Warren Strain, State Teachers College, Slippery Rock, Pennsylvania. "The Kaiser Company, Inc., of ship building fame, is completing a high alloy iron and steel project near Fontana, about thirty-five miles east of Los Angeles. Here among the vineyards, orange and walnut groves is a blast furnace utilizing iron ore from San Bernardino County, ninety coke ovens depending upon Utah coal, six open hearth steel furnaces and a rolling mill already engaged in turning out plate for battle ships. Two additional units are being added. This project, like many others developed by Kaiser, has been put into operation in record time. The citizens of southern California anticipate a much greater independence from eastern manufacturers."

According to the Chief of Army Ordnance, the United States has an anti-aircraft gun capable of firing shells to a height of 60,000 feet, a range higher than planes now fly. This is the 120 millimeter gun. It fires automatically and with great speed, discharging a 50-pound shell. It is towed about on eight pneumatic-tired wheels, giving it great mobility. It can be used in horizontal as well as vertical firing.

The world's greatest gardenia nursery marketed about four million gardenias last year. This nursery is about ten miles south of San Francisco on the peninsula. Greenhouse temperatures ideal for gardenias are comparatively easy to maintain there, with little chance of being overheated in summer. When the business started fifty years ago, commercial production was limited to a short growing season. By cross breeding, especially with strains imported from Genoa, Italy, and by forced feeding, gardenias now bloom the year around. They are shipped in refrigerated express cars or by air express, about half going to Chicago jobbers for distribution in the Middle West. Thus far the gardenia has resisted all attempts to breed color in the flower.

The new 20-inch products pipe line of the War Emergency Pipelines, Inc., was completed from Texas to the East Coast last December. It required 225 days to com-

plete this project, in contrast with 350 days required to complete the WEP 24-inch pipe line. In the WEP products pipe line there are 1,475 miles of 20-inch, 62 miles of 16-inch and 115 miles of branch-feeder and distribution lines with diameters from 6-inch to 14-inch. During December shipments of crude oil thru the 24-inch line approximated 300,000 barrels daily, which is its rated capacity.

DR. LOYAL DURAND, JR., assumed his duties as Associate Professor in Geography at the University of Tennessee on February 1. Professor Durand taught at the University of Wisconsin from 1924 until the close of the first semester 1943-44.

GEOGRAPHICAL PUBLICATIONS

Preston E. James. **An Outline of Geography.** 475 pp.; illus., appendixes, maps, index.

Clyde F. Kohn. **A Study Guide.** 77 pp., maps. Ginn and Company, Boston. 1943.

The professional participation of geographers in the war program has awakened a wide interest in geography. These efforts have also emphasized the fact that there is disagreement within the ranks. One of the points on which all are not agreed is the initial collegiate level of geographic thinking. This is clearly indicated by James' *Outline* and its accompanying *Study Guide*.

An Outline of Geography is well known and needs no review. It is a scholarly book on a high level of geographic thinking. A *Study Guide* is an orthodox outline of the material presented in the first two courses in many colleges and universities and in the Army Specialized Training Program, Geography: AST-163, Term 1 and Term 2. Course I, Earth Conditions of Human Society, deals with the physical conditions and world patterns of the elements of the natural environment, whereas Course II, Utilization of Earth Resources, is concerned with economic occupance. Both courses follow a topical outline. The student is effectively "guided" into the subject but there he is left to sink or swim in the midst of a mass of facts and questions.

Both *An Outline of Geography* and *A Study Guide* can stand on their own merits; as a unit they are highly unsatisfactory. By a liberal use of the appendixes Course I makes use of the text. Course II is especially troublesome. Scattered references to about 125 pages of *An Outline* together with some suggested reading leaves much to be desired. *A Study Guide,* with proper page references, could be much more appropriately based on other texts. The difficulty lies in an attempt to combine two different levels of geographic thinking. There is no question of the need for both types of work. The fact that most collegiate introductory sequences follow a topical approach similar to that presented in *A Study Guide* does not destroy the value of *An Outline of Geography* as a regional presentation at a different level. It is somewhat difficult, however, to accept one as the study guide to the other.

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